

OVERCOMING INFRASTRUCTURE (HARD & SOFT ITEMS) CHALLENGE IN INDONESIA

By



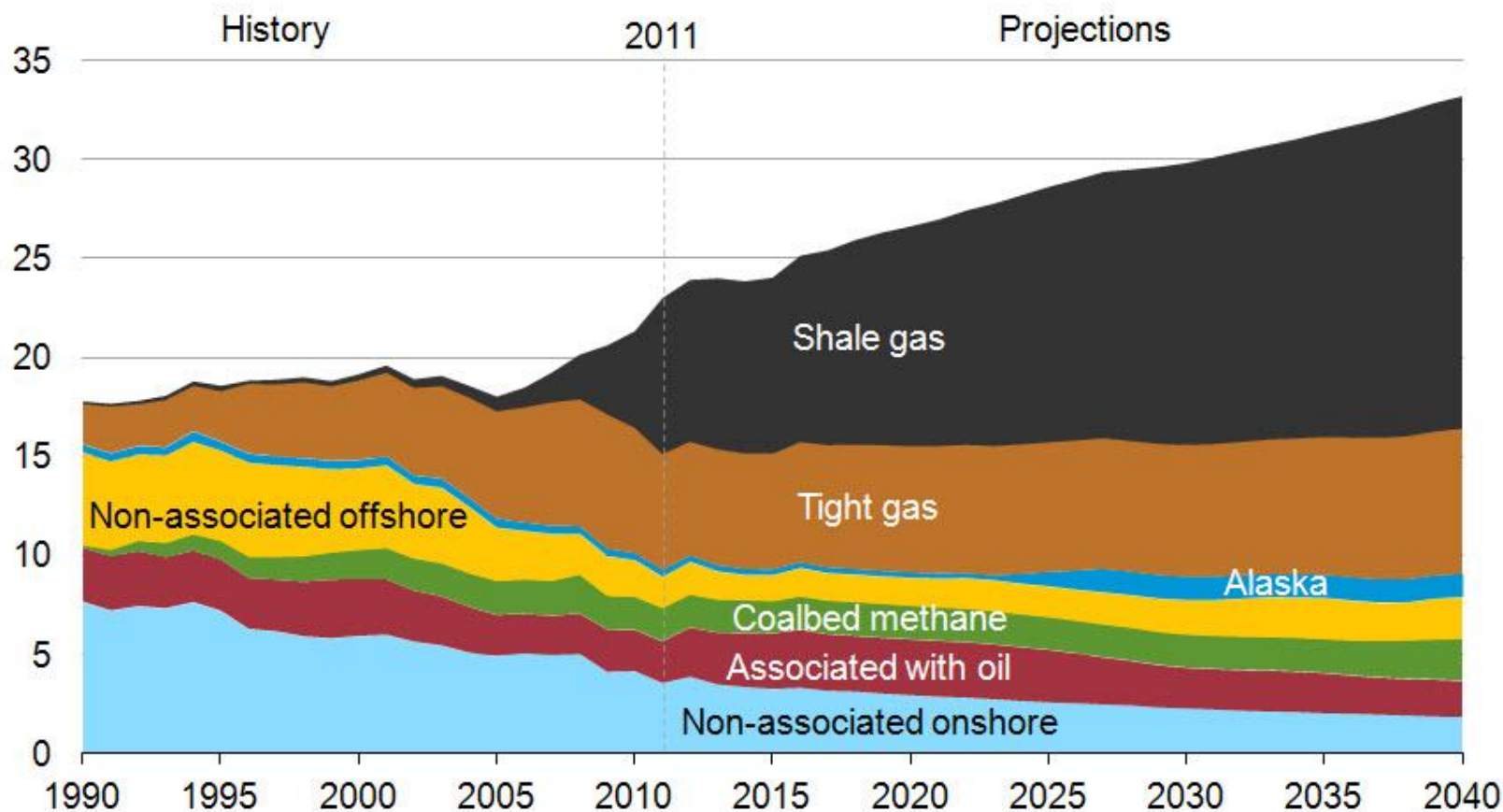
**Dr. Baldeo Singh, CEO
Black Diamond Energy**

**A REGIONAL WORKSHOP on the
CHANGING GLOBAL GAS MARKET and UNCONVENTIONAL GAS**
UNDER THE U.S.-ASIA PACIFIC COMPREHENSIVE ENERGY PARTNERSHIP
MAY 6 – 8, 2013 – Gran Melia Hotel, Kuningan, JAKARTA, INDONESIA



US Success Story

U.S. dry natural gas production
trillion cubic feet



Source: U.S. Energy Information Administration, *Annual Energy Outlook 2013 Early Release*



Infrastructure – Hard & Soft

- US success – A Case History
- Opening of large NEW areas for shale development
 - Challenge and Opportunity
- Evolution of shale revolution – Time Line
 - Barnett, Legacy Gas Play (5 BCF/D – 800,000 BOE/D)
 - Bakken, Oil Play (800,000 BO/D), LARGEST OIL FIELD?
 - Eagle Ford, Mixed – Gas & Liquids (800,000 BOE/D)
- Technology and Equipment
 - Horizontal drilling and Fracturing
- Soft Infrastructure – Regulatory & Government Support
 - Specific Issues to Indonesia

Shale Plays in Lower 48 States



Source: Energy Information Administration based on data from various published studies.
Updated: May 9, 2011

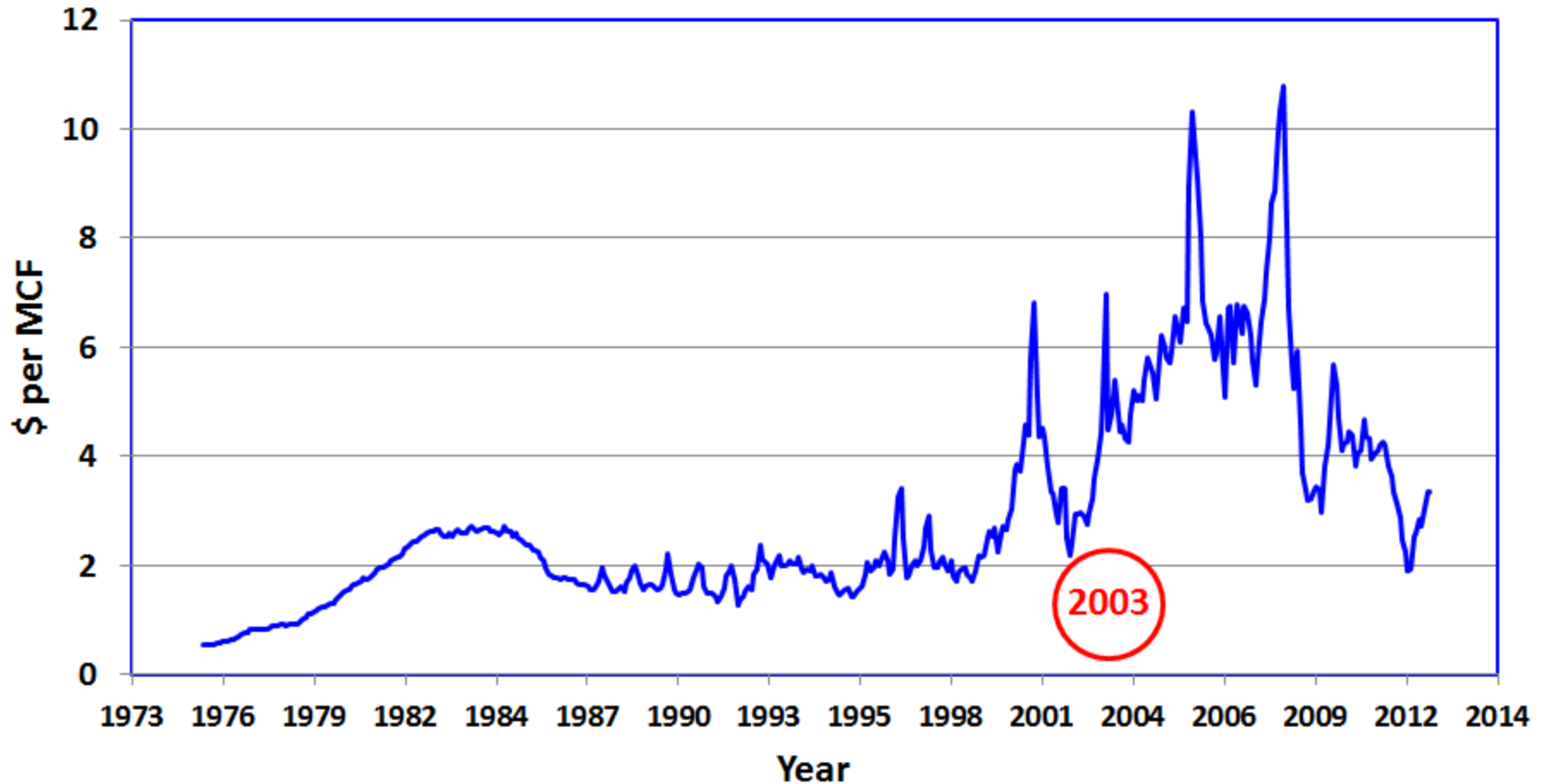


Shale Revolution – Time Line

Time (Year)	Events
1940s	First use of hydraulic fracturing in Grant County, KS
1977	US DOE initiates methane recovery from CBM
1978 - 1992	US DOE effort in fracture technology & mapping techniques to produce gas from deep shales – Eastern Gas Shale Project
1980 - 2002	Tax Credit for shale gas development
1991	Publicly funded Gas Research Institute (GRI) and US DOE subsidize Mitchell Energy's first horizontal well
1997	Mitchell Energy achieves economical shale gas extraction in the Barnett Shale using slick-water fracturing & mapping techniques
2003	Confluence of technology, infrastructure & favorable gas price
2013	Barnett Shale – 5 BCF per day (~ 800,000 barrels oil equivalent) Bakken Shale – ~ 1 million barrels per day; Over 200 rigs in action Eagle Ford Shale – 700,000 barrels per day



Historical Natural Gas Wellhead Price in the USA



Barnett Shale (Gas) 5 BCF/D (800,000 BOE/D)

Barnett Shale Drilling From 1981 to 2010 Ft. Worth Basin, Texas

2010

Barnett Shale Producers

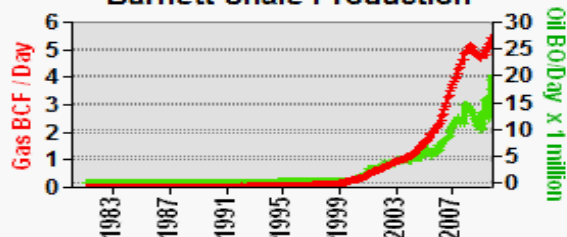
- Horizontal (red)
- Vertical (black)

- Urban Areas
- Barnett Shale Limit

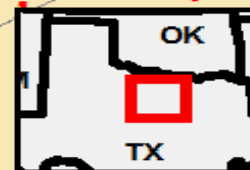
Barnett Shale Events

- 1981- 1st production; foam fracs
- 1985- Massive gel fracs
- 1997- Core analysis: gas-in-place = 3 x previous estimates
- 1997- Water fracs lower costs
- 1999- Refracs restore production
- 2003- Horizontal drilling expands

Barnett Shale Production



Miles
0 5 10



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Barnett Shale under Dallas-Fort Worth Airport



Source: ALL Consulting, 2008

Shale Gas Activity at Dallas-Fort Worth International Airport

Bakken Shale (Oil) – 800,000 BO/D

Bakken Shale Production 1985-2010 Williston Basin, ND & MT

2010

Bakken Shale Producing Wells Bbl Oil per Day (Mean per Quarter)

- 0 - 100
- 101 - 500
- > 500

Gas-Oil Ratio (Mean per Quarter)

- 0 - 1,000 (Oil Bbl >>> Gas BOE)
- 1,001 - 6,000 (Oil Bbl > Gas BOE)
- > 6,000 (Gas BOE > Oil Bbl)

Bakken Depositional Limit

Miles

0 20 40

1996: Middle Bakken
Vertical well Tests
Elm Coulee Field

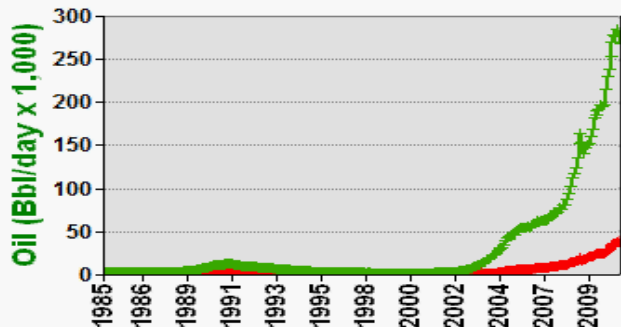
2000: Elm Coulee
Middle Bakken
Horizontal wells
Discovery

1987:
Upper Bakken Shale
Horizontal Wells
Billings Nose

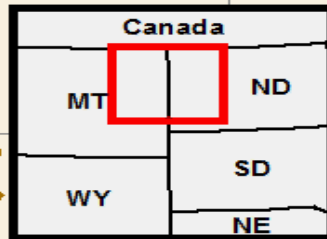
1976:
Upper Bakken Shale,
Vertical wells
Billings Nose

Bakken Shale Production

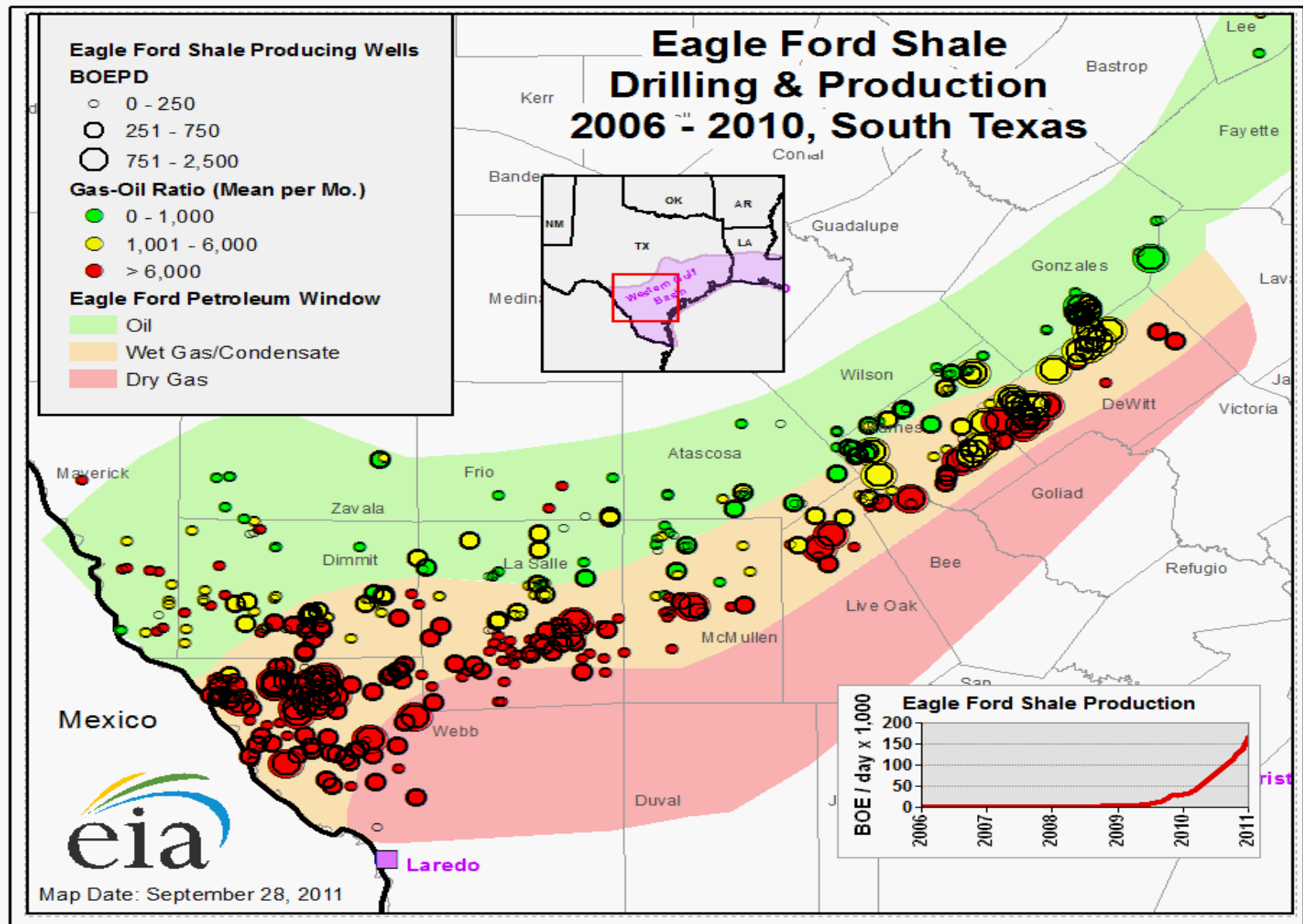
Gas (Bbl of Oil Equiv. / Day x 1,000)



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Eagle Ford (Gas & Liquids) – 800,000 BOE/D





Infrastructure – Hard Items

- Large number of wells – 1,000's of wells
- Long horizontal wells
- Multi-stage fracturing
 - Land access – Pad Drilling
 - Large vehicles (Timber logging trucks!)
- Water usage in fracturing: Trucking
- **Sand, proppant and chemical logistics**
- G&G seismic crews
- High paying local employment – Good news
- Housing and accommodation



Marcellus Shale Gas Fracturing





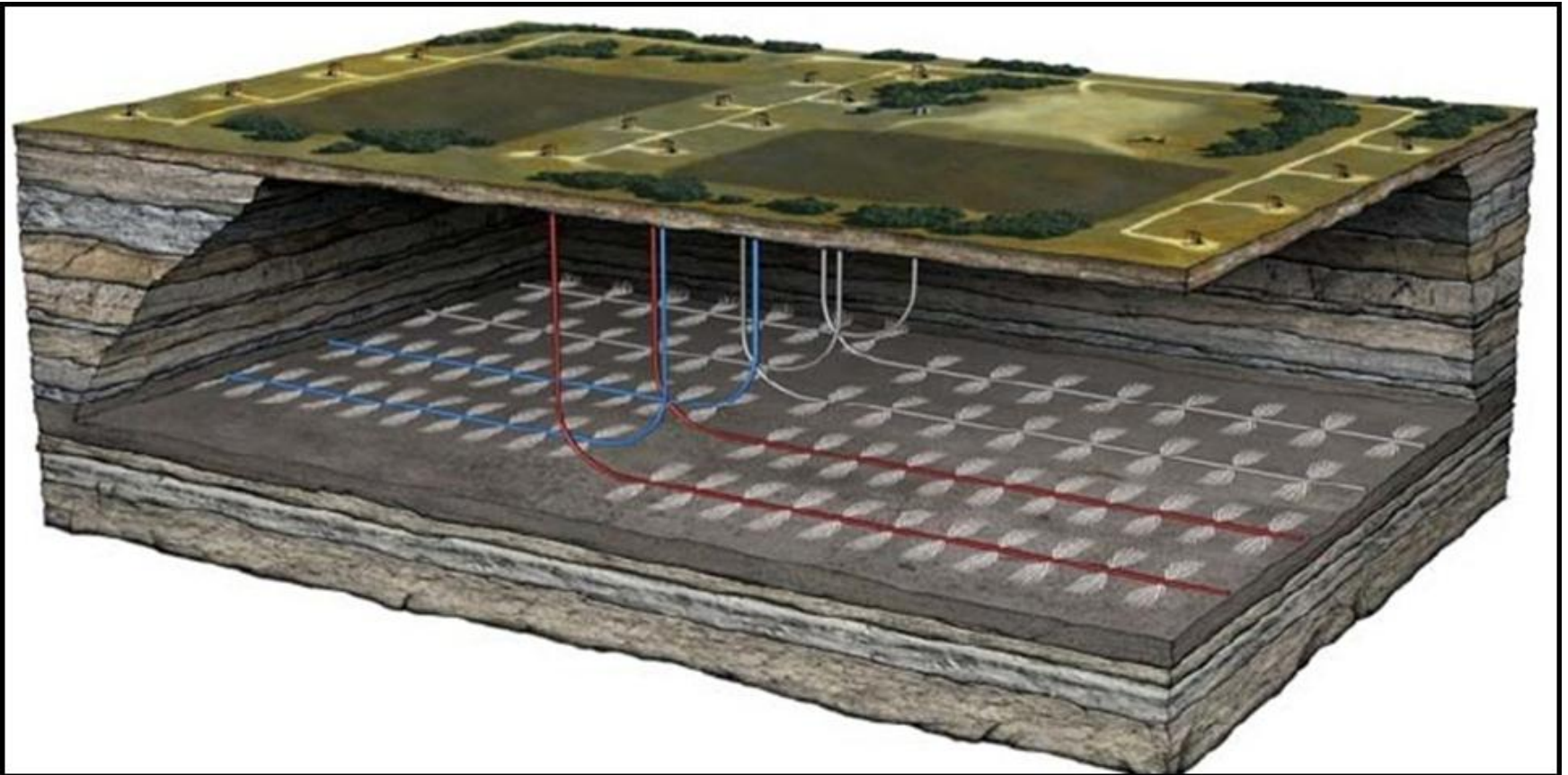
Pad Drilling – A Major Change





Infrastructure – Hard Items

Horizontal wells, Pad drilling and Multi-stage fracking





Infrastructure – Soft Items

Overlap issues in PSC environment in Indonesia

- Distribution of conventional & unconventional (shale and CBM) resources in the earth – Depth of deposits
 - CBM is very shallow – above conventional
 - Shale is a deep play – below conventional

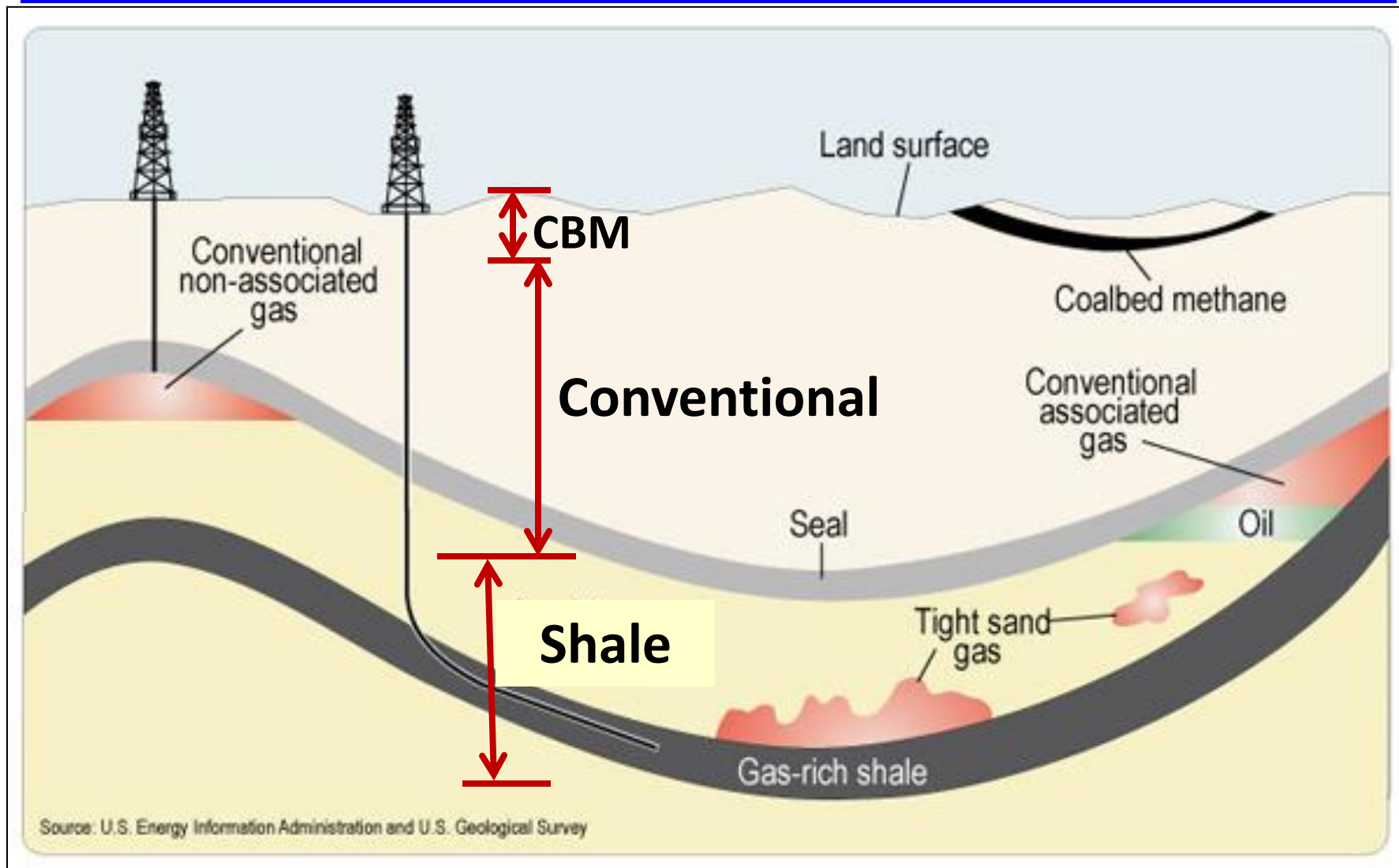
Terms & Conditions for exploration & development

- Unconventionals are hard to produce, large number of wells and expensive
 - CBM has Contractor Split $\geq 40\%$
 - Shale oil & gas should be even better
 - Conventional splits for Contractor $\sim 15\%$



Infrastructure – Soft Items

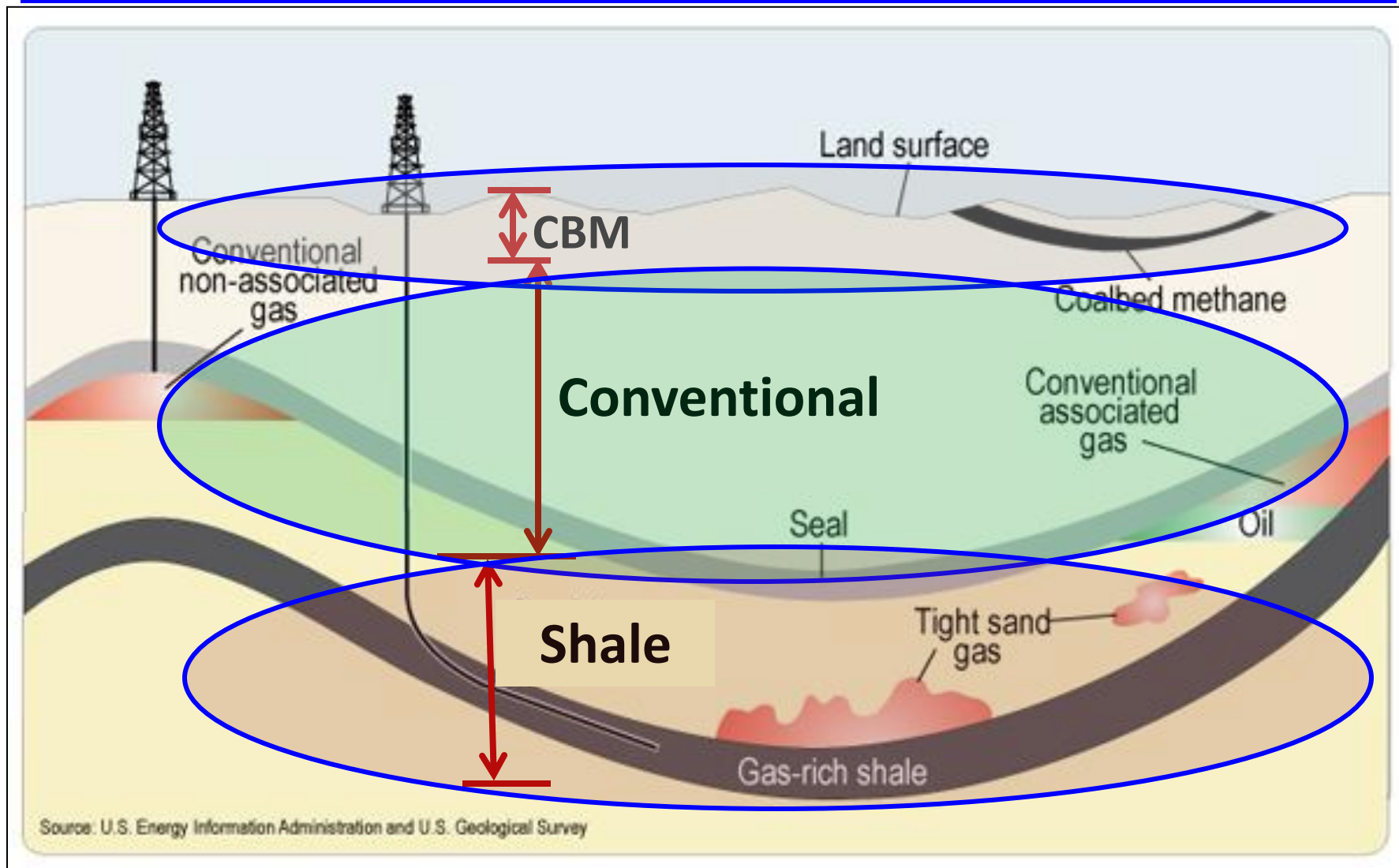
Overlap Issue in PSC





Infrastructure – Soft Items

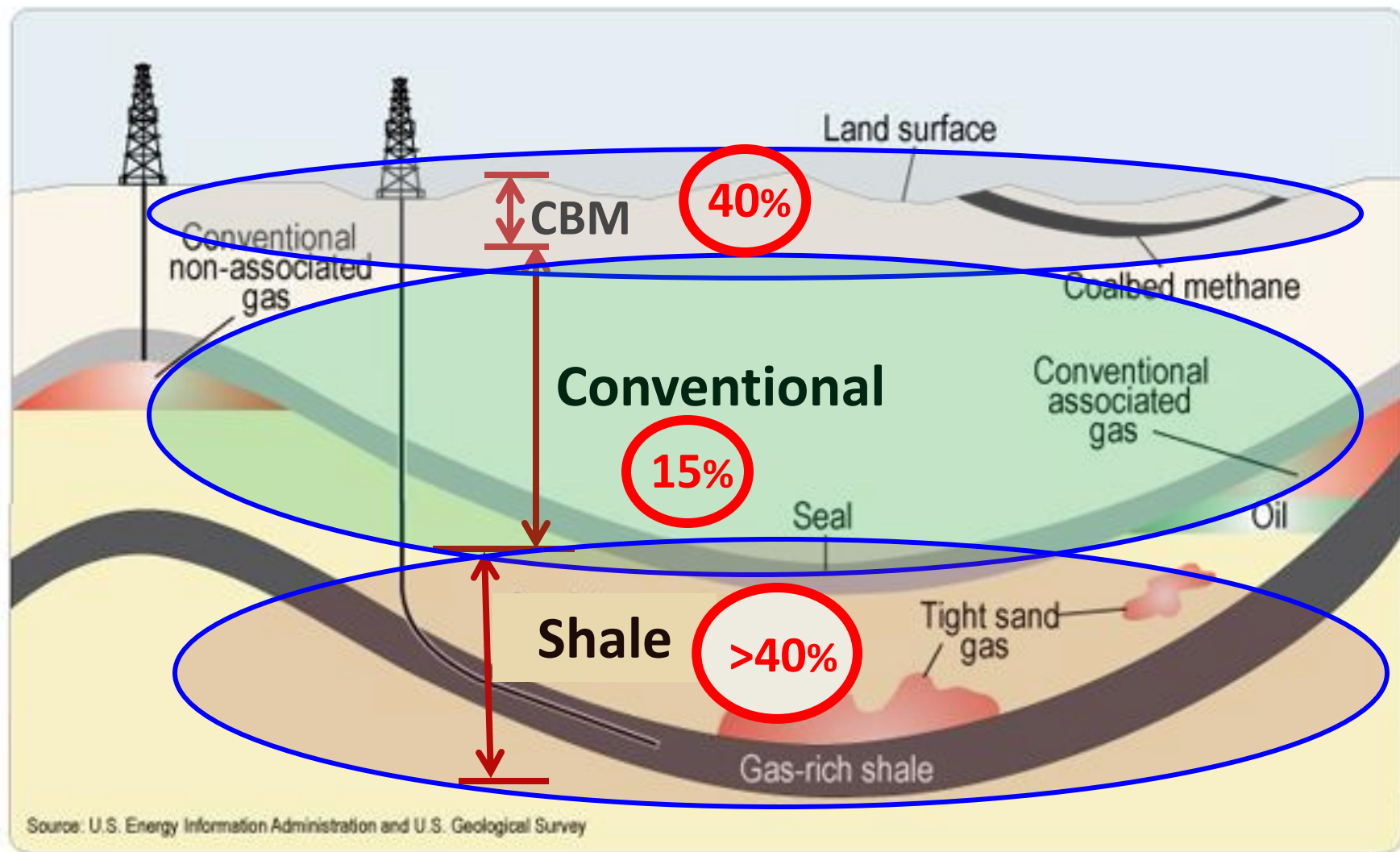
Overlap Issue in PSC





Infrastructure – Soft Items

Contractor Take for the PSC **?%**





Infrastructure – Soft Items

Training and Safety

- **Training** – Similar to conventional but expanded activity level, many more personnel
- Added focus on horizontal drilling & fracking
- Sustained activity would lead to bigger pool of high-skilled workforce in drilling, production & G&G
- Positive impact on conventional exploration
- **Safety** – Known basins with history of understanding
- Limited well deliverability and drainage area
- Continuous improvement due to sustained activities will result in general improvement in safety.

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